N92-14513

SUMMARY OF UPPER ATMOSPHERIC RESEARCH

A. Title of Research Task: Whole Air Sampler

B. Investigators and Institutions:

James F. Vedder NASA Ames Research Center

C. Abstract of Research Objectives: Minor constituents play an important role in upper atmospheric photochemistry and serve as tracers in transport and mixing studies in tropospheric-stratospheric exchange processes. Measurements of trace gases are essential to an understanding of the mechanisms by which minor constituents originating in the troposphere, both naturally occurring and anthropogenic, reach the stratosphere; data on tracer distributions thus acquired are important in the development of models for predicting photochemical effects in the stratosphere.

D. Progress and Results: The work reported here is a joint effort of NASA Ames Research Center and the National Center for Atmospheric Research. NCAR is funded separately by NASA Headquarters. Air collected in stainless steel canisters by the automated whole-air sampler (WAS) on the ER-2 and the manually operated sampler on the DC-8 was analyzed by gas chromatography. The data on 8 trace gases (CH4, CO, N2O CF2Cl2, CFCl3, C2F3Cl3, CH3CCl3, and CCl4) reported in the field during the Airborne Antarctic Ozone Experiment based in Punta Arenas, Chile, were validated and presented at the Polar Ozone Workshop in Snowmass, CO, in May, 1988. Subsequently, a paper on these results was submitted to the Journal of Geophysical Research and will appear in a special issue in 1989. Some of the data was used in five other co-authored papers in the special issue.

In February, 1989, the WAS along with the Harvard ClO instrument and the NASA Ames Research Center ozone photometer participated in an ER-2 flight to 61°N latitude in an attempt to enter the polar vortex. Although the ER-2 reached only the maximum wind region of the polar jet stream, interesting results were obtained. The low levels of the measured values of the long-lived trace gases confirmed the expected descent of cold polar air at high latitudes.

The whole-air samplers were again carried aboard the ER-2 and DC-8 during the Airborne Arctic Stratospheric Expedition based in Stavangar, Norway, December to February, 1989. The mixing ratios for 8 trace gases were reported in the field. The results of the analyses of the ER-2 samples were often available within one day of the return of an ER-2 flight. An additional gas chromatograph was operated at the site to measure other trace species of interest. Analyses and validation of the results are continuing.

E. Journal Publications

1) In Situ Northern Mid-Latitude Observations of ClO, O3, and BrO in the Wintertime Lower Stratosphere (1988): W. H. Brune, D. W. Toohey, J. G. Anderson, W. L. Starr, J. F. Vedder, and E. F. Danielsen, Science, 242, 558-562

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2) Trace Gases in the Antarctic Atmosphere (1989): L. E. Heidt, J. F. Vedder, W. H. Pollock, R. A. Lueb, and B. E. Henry, J. Geophys. Res.

3) Transport into the South Polar Vortex in Early Spring (1989): D. L. Hartmann, L. E. Heidt, M. Loewenstein, J. R. Podolske, J. F. Vedder, W. L. Starr, and S. E. Strahan, J. Geophys. Res.

4) Lagrangian Photochemical Modelling Studies of the 1987 Antarctic Spring Vortex. Part I: Comparison with AAOE Observations (1989): R. L. Jones, J. Austin, D. S. McKenna, J. G. Anderson, D. W. Fahey, C. B. Farmer, L. E. Heidt, K. K. Kelly, D. M. Murphy, M. H. Proffitt, A. F. Tuck, and J. F. Vedder, J. Geophys. Res.

5) Dehydration in the Lower Antarctic Stratosphere During Late Winter and Early Spring, 1987 (1989): K. K. Kelly, A. F. Tuck, D. M. Murphy, M. H. Proffitt, D. W. Fahey, R. L. Jones, D. S. McKenna, M. Loewenstein, J. R. Podolske, S. E. Strahan, G. V. Ferry, K. R. Chan, J. F. Vedder, G. L. Gregory, W. D. Hypes, M. P. McCormick, E. V. Browell, and L. E. Heidt, J. Geophys. Res.

6) Nitrogen and Chlorine Species in the Spring Antarctic Stratosphere: Comparison of Models with AAOE Observations (1989): J. M. Rodriguez, M. K. W. Ko, N. D. Sze, S. D. Pierce, J. G. Anderson, D. W. Fahey, K. K. Kelly, C. B. Farmer, G. C. Toon, M. T. Coffey, L. E. Heidt, W. G. Mankin, K. R. Chan, W. L. Starr, J. F. Vedder, and M. P. McCormick, J. Geophy. Res.

Biennial Research Summary

A. **Title of Research Task:** Whole Air Sampler

B. **Investigators and Institutions:**

Leroy E. Heidt National Center for Atmospheric Research

C. **Abstract of Research Objectives:** Minor constituents play an important role in upper atmospheric photochemistry and serve as tracers in transport and mixing studies in tropospheric-stratospheric exchange processes. Measurements of trace gases are essential to an understanding of the mechanisms by which minor constituents originating in the troposphere, both naturally occurring and anthropogenic, reach the stratosphere; data on tracer distributions thus acquired are important in the development of models for predicting photochemical effects in the stratosphere.

D. **Progress and Results:** The work reported here is a joint effort of the National Center for Atmospheric Research and NASA Ames Research Center. NCAR is funded separately by NASA Headquarters. Air collected in stainless steel canisters by the automated whole-air sampler (WAS) on the ER-2 and the manually operated sampler on the DC-8 was analyzed by gas chromatography. The data on 8 trace gases (CH_4, CO, N_2O, CF_2Cl_2, $CFCl_3$, $C_2F_3Cl_3$, CH_3CCl_3, and CCl_4) reported in the field during the Airborne Antarctic Ozone Experiment based in Punta Arenas, Chile, were validated and presented at the Polar Ozone Workshop in Snowmass, Colorado, in May, 1988. Subsequently, a paper on these results was submitted to the *Journal of Geophysical Research* and will appear in a special issue in 1989. Some of the data was used in six other co-authored papers in the special issue.

In February, 1989, the WAS along with the Harvard ClO instrument and the NASA Ames Research Center ozone photometer, participated in an ER-2 flight to 61°N latitude in an attempt to enter the polar vortex. Although the ER-2 reached only the maximum wind region of the polar jet stream, interesting results were obtained. The low levels of the measured values of the long-lived trace gases confirmed the expected descent of cold polar air at high latitudes.

The whole-air samplers were again carried aboard the ER-2 and DC-8 during the Airborne Arctic Stratospheric Expedition based in Stavanger, Norway, December, 1988 to February, 1989. The mixing ratios for 8 trace gases were reported in the field. The results of the analyses of the ER-2 samples were often available within one day of the return of an ER-2 flight. Additionally, a mass spectrometer/gas chromatograph was operated at the site to measure other trace species of interest. Analyses and validation of the results are continuing.

E. **Journal Publications**

1) Trace Gases in the Antarctic Atmosphere (1989): L. E. Heidt, J. F. Vedder, W. H. Pollock, R. A. Lueb, and B. E. Henry, *J. Geophys Res.*

2) Transport into the South Polar Vortex in Early Spring (1989): D. L. Hartmann, L. E. Heidt, M. Loewenstein, J. R. Podolske, J. F. Vedder, W. L. Starr, and S. E. Strahan, *J. Geophys. Res.*

3) Lagrangian Photochemical Modeling Studies of the 1987 Antarctic Spring Vortex, Part I: Comparison with AAOE Observations (1989): R. L. Jones, J. Austin, D. S. McKenna, J. G. Anderson, D. W. Fahey, C. B. Farmer, L. E. Heidt, K. K. Kelly, D. M. Murphy, M. H. Proffitt, A. F. Tuck, and J. F. Vedder, *J. Geophys. Res.*

4) Dehydration in the Lower Antarctic Stratosphere During Late Winter and Early Spring, 1987 (1989): K. K. Kelly, A. F. Tuck, D. M. Murphy, M. H. Proffitt, D. W. Fahey, R. L. Jones, D. S. McKenna, M. Loewenstein, J. R. Podolske, S. E. Strahan, G. V. Ferry, K. R. Chan, J. F. Vedder, G. L. Gregory, W. D. Hypes, M. P. McCormick, E. V. Browell, and L. E. Heidt, *J. Geophys. Res.*

5) Nitrogen and Chlorine Species in the Spring Antarctic Stratosphere: Comparison of Models with AAOE Observations (1989): J. M. Rodriguez, M. K. W. Ko, N. D. Sze, S. D. Pierce, J. G. Anderson, D. W. Fahey, K. K. Kelly, C. B. Farmer, G. C. Toon, M. T. Coffey, L. E. Heidt, W. G. Mankin, K. R. Chan, W. L. Starr, J. F. Vedder, and M. P. McCormick, *J. Geophys. Res.*

6) Lagrangian Photochemical Modeling Studies of the 1987 Antarctic Spring Vortex, Part 2: Seasonal Trends in Ozone: J. Austin, R. L. Jones, D. S. McKenna, A. T. Buckland, J. G. Anderson, D. W. Fahey, C. B. Farmer, L. E. Heidt, M. H. Proffitt, A. F. Tuck, J. F. Vedder, *J. Geophys. Res.*